Light Water Analysis and Volatile Extraction (Light WAVE). Aaron. J. Paz and Koorosh Araghi, NASA Johnson Space Center (2101 NASA Parkway, Houston TX 77058; Aaron.Paz-1@nasa.gov)

Introduction: The presence of water ice in permanently shadowed regions on the lunar surface may enable a sustained human presence on the Moon with minimal need for consumables. The first step toward utilizing lunar water ice to advance human space exploration will be to determine the abundance, accessibility, and distribution of this valuable resource

Current Knowledge of Lunar Water Ice Concentration: We currently have one data point for lunar water concencentration, which was determined to be 5.6% +/- 2.9% water by mass in Cabeus crater by the LCROSS mission [1]. The upcoming PRIME-1 and VIPER missions should provide more data, but these are the first steps toward a campaign that will likely be necessary in order to determine appropriate locations and requirements for lunar water ice mining [2]. Future missions will be necessary to acquire more knowledge and also to demonstrate critical functions such as icy regolith handling and water capture that will be necessary for In-Situ Resource Utilization.

State of the Art: The upcoming water prospecting missions PRIME-1 and VIPER both use a drill and mass spectrometer to detect water. However, water is intentionally released to the vacuum of space so the functions of volatile retention and water capture will not be addressed. The ProSPA instrument being developed by the European Space Agency requires icy regolith sample handling, but the small sample size and finite number of sample containers could restrict ProSPA from being utilized during mobile prospecting missions.

Light WAVE: The Light Water Analysis and Volatile Extraction system was designed to capture icy regolith samples acquired from a drill. Regolith samples are then weighed, sealed, and heated to release volatiles. Volatiles are captured in a volume with a known temperature and the ideal gas law is used to determine the total quantity of volatiles in the volume. The composition of the volatile mixture is determined using a mass spectrometer so that each volatile can be quantified. By quantifying the amount of water extracted from the regolith sample, and acquiring the mass of the sample, volatile concentration by mass can be determined. The relatively large sample containers used in LightWAVE, combined with no inherent limit on the number of samples that can be processed, make this system capable of capturing enough water to enable a lunar water sample return mission, and makes it ideal for mobile prospecting missions.

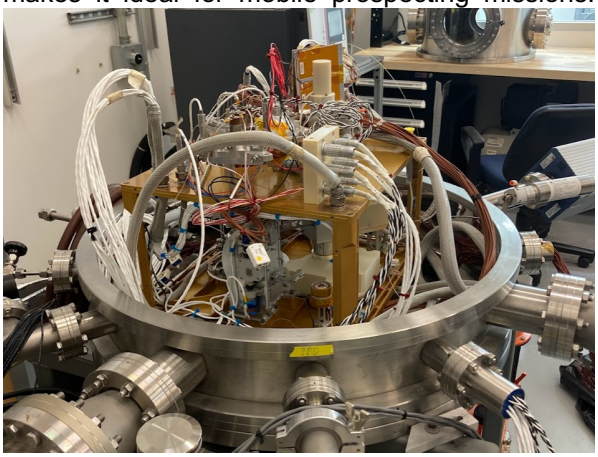

Figure 1: LightWAVE System

References:

[1] Colaprete, A., et. al.(2010). Detection of water in the LCROSS ejecta plume. *science*, *330*(6003), 463-468. [2] Kleinhenz, J.,et. al. (2020). *Lunar Water ISRU Measurement Study (LWIMS): Establishing a Measurement Plan for Identification and Characterization of a Water Reserve* (No. E-19884).